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MIXED FRACTIONAL HESTON MODEL AND THE PRICING OF AMERICAN OPTIONS

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Abstract

This paper presents a fractional version of the Heston model in which the volatility Brownian and price Brownian are replaced by mixed fractional Brownian motions with Hurst parameter $H \in (\frac{3}{4}, 1)$ so that the model exhibits a long range dependence. Then the existence and uniqueness of solution of mixed fractional Heston model are discussed as well as the error of an Euler scheme applied on this model. Finally, some numerical illustrations are given in the last section by computing American put option prices.

Keywords: Heston model, Mixed fractional Brownian motion, Euler discretization method, American option.
MSC: 60G22, 97M30

1 Introduction

In classical quantitative finance, Brownian motion plays a key role in financial models [1]. There are many models so that their risky asset price dynamic is driven by the Brownian motion; but along with all the advantages of classical Brownian motion, empirical studies have given strong evidence against the traditional asset pricing model based on Brownian motion in which returns have the independent normal distribution. Investigation of the financial market show that there is long-range dependence property in the financial models [2, 3]. Regardless of the dependent return, using Brownian motion to display random part of financial models may have some serious disadvantages.

Fractional Brownian motion (*fBm*) was originally introduced by Mandelbrot and van Ness in 1968 [4]. In recent decades, many researchers have focussed their studies on this process and used it to express the random part of financial models [5, 6, 7, 8, 9, 10, 11, 12, 13]. The self-similarity and long-range dependence properties are the most significant reasons of why researchers concentrate more on this stochastic process. Nevertheless, existence this process in financial models can cause some problems. It can be shown that except the case $H = \frac{1}{2}$, the *fBm* process is neither a Markov process nor a semimartingale and therefore there can be no equivalent probability under which the process becomes a local martingale [14]. This almost implies that there is arbitrage [15, 16]. In